Performance Modeling and Analysis for Software Integration

Kang G. Shin

Real-Time Computing Laboratoty

Department of EECS

The University of Michigan

Ann Arbor, MI 48019-2122

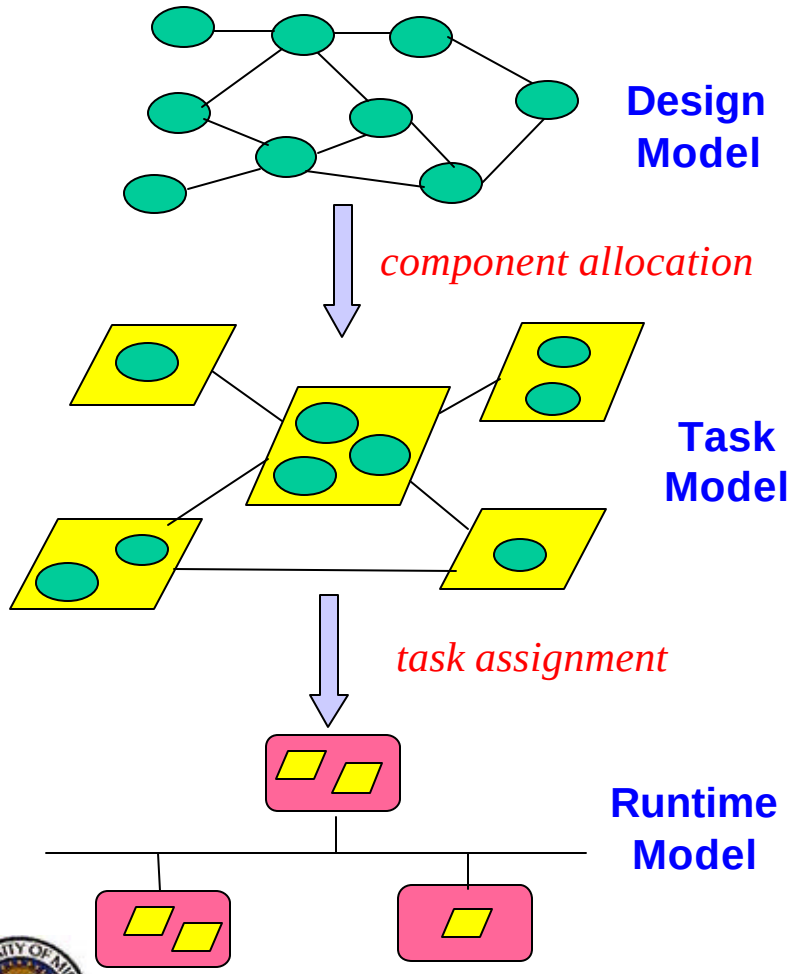
What makes SW building so hard?

- Getting too big
- Requiring too many things
- Omnipresent, especially mission- and safety-critical embedded applications
- Very long-lived, e.g., aircraft, so evolves over a long period
- Difficult to model system, analyze, test/verify model-generated or hand-coded SW against real system requirements

Promising Technologies

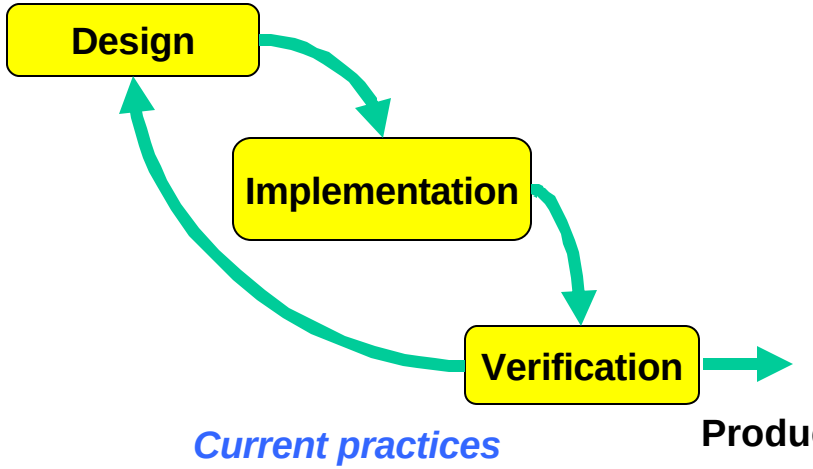
- **Software *synthesis***
  - **Component/model integration**
  - **Model-based code generation**
- **Heterogeneous *modeling***
  - **Different models used for different development phases**
- **System *analysis***
  - **Focuses on design-time analysis**
  - **Tries to analyze both functionality and *performance***
  - **Verifies correctness by analysis instead of simulation**

Software Integration Process



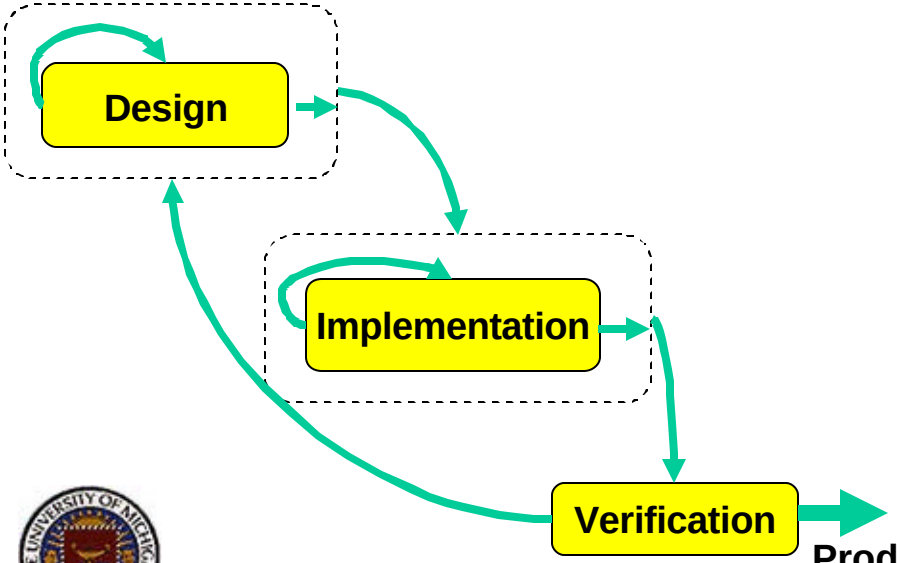
- **Technical Barriers**
  - **Only functional specification is available at design time**
  - **Performance depends on**
    - **system structure**
    - **implementation**
    - **platform**
  - **Heterogeneous models/tools**
  - ***Little performance information available before prototyping***
- **Performance model**
  - **Usable with different functional models**
  - **Used for analyses at all development phases**

Why Performance Model?



Current practices

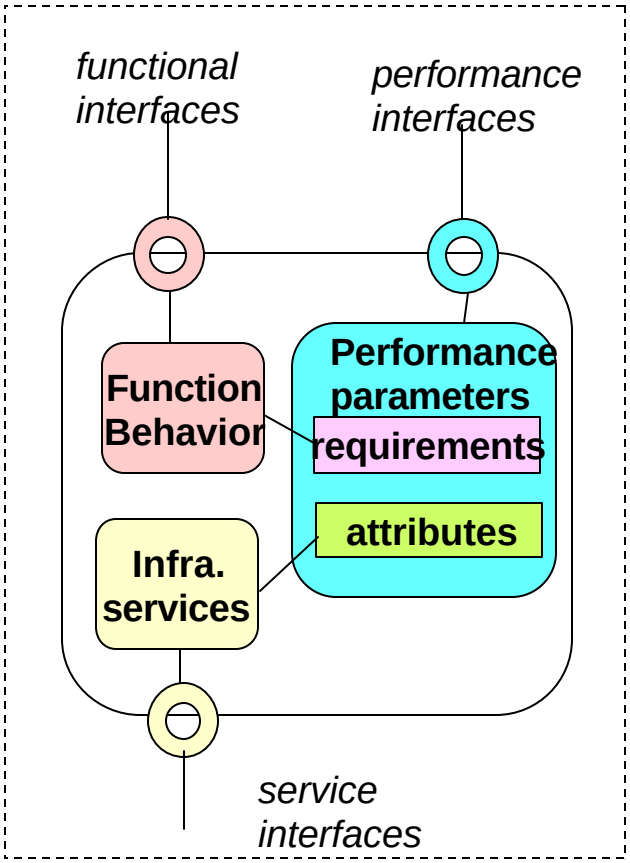
- No performance check at each step
- Errors detected at the end
- Long development cycle

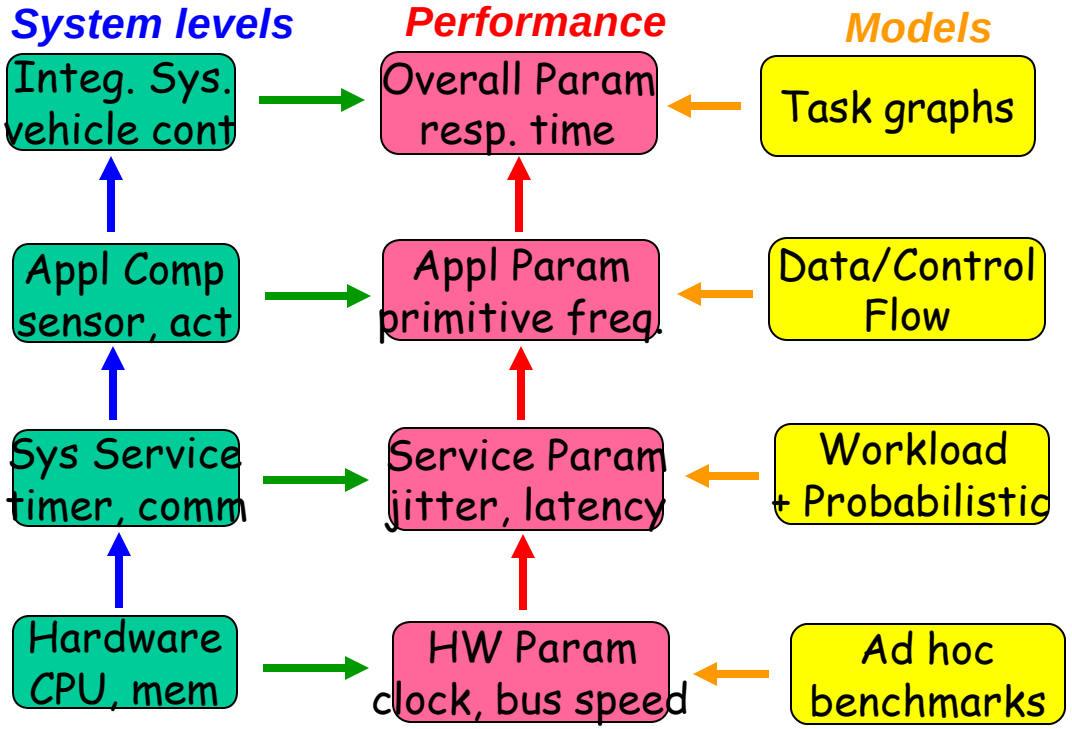


Practice with performance model

- Performance check at *each step*
- Performance issues first resolved locally (within each step)
- Shorter development cycle

A Possible Solution





1. *Associate performance information with components*
2. *Construct a hierarchical performance model corresponding to the system model*

Sample Issues

- **What is essential performance information?**
  - **Application requirements**
  - **Infrastructure capability**
- **How to represent performance information?**
  - **Modeling methods**
  - **Specification languages, e.g., aspect-oriented?**
- **How to support SW development with performance information?**
  - **Design-time : component selection & integration, platform configuration, attribute tradeoff analysis, change propagation**
  - **Runtime adjustment: reconfiguration, attribute adaptation.**